THE POLLINATION ECOLOGY OF A POPULATION OF ERYTHRONIUM AMERICANUM KER. (LILIACEAE)

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There are considerable gaps in our knowledge of the complete life history of the indigenous species of vernal flowering herbaceous angiosperms. The anecdotal information presented in local flora guides is an aid to the identification of populations, but it does not always help us to appreciate the evolutionary significance of floral and vegetative modifications. Nor can it explain the subtle interactions between one species and other plant and animal populations within the vernal community.

While the vegetative propagation of *Erythronium americanum* has been well documented (Gleason & Cronquist, 1963), floral reproduction has been poorly recorded. Does the pollination of the flower lead to the production of fruit and seed in this species? How is the transmission of the pollen effected? Work done on the pollination ecology of several vernal species has shown that a variety of reproductive strategies may be employed under surprisingly similar restrictive environmental conditions (Proctor & Yeo, 1972).

The phenology and anatomy of *Erythronium americanum* flowers suggest pollination by insect vectors. The bright yellow perianth displays the bell/ funnel form (Faegri & van der Pijl, 1971) while the nodding peduncle would restrict foraging to vectors that could feed while hovering or by clinging in an inverted position. Macior (1966, 1970) has found that Hymenoptera active at this time of year are capable of the latter style of feeding and pollination.

The study reported here had two objectives. First, using experimental methods in the field, it sought to determine the mode or modes of floral reproduction that lead to the development of seed and fruit. Second, it sought to identify the vectors (if any) of pollination.

STUDY SITE AND STUDY POPULATION

The population of *Erythronium americanum* studied is located in Swartout's Woods of the State University College at Brockport campus, in the town of Sweden, the village of Brockport in Monroe County, New York. The forest canopy consists of mature silver

maple mixed with beech saplings. Anthesis of *Erythronium americanum* overlapped the anthesis of local populations of *Trillium grandiflorum* (Michx.) Salisb., *Hepatica acutiloba* DC., *Dicentra cucullaria* (L.) Bernh., *Dentaria laciniata* Muhl., *Trillium erectum* L. and *Caulophyllum thalictroides* L. Flowers of *Erythronium americanum* began to bloom on April 25, 1975, and withered entirely by May 10, 1975.

PROCEDURE

The field study was begun on April 20, 1975, and was concluded on May 25, 1975. Just prior to blooming, sixty flower buds were chosen at random over the entire colony. Each bud selected was placed in a transparent plastic bag and sealed with thread. Following the opening of the perianth, fifteen blossoms were placed in each of four experimental categories listed and defined below.

Controls: Following the onset of anthesis, the bag was removed. Fruit produced in this category should give a normal indication of the rate of fruit production in the population.

Emasculates: Following the onset of anthesis, the bag was removed and the anthers excised. If fruit is produced in this category, fertilization is initiated by foreign pollen that must be transmitted by a vector.

Isolates: Following the onset of anthesis, the bag was not removed. If those flowers that are denied access to foreign pollen set fruit, then fertilization is via self-pollination.

Isolated Emasculates: Following the onset of anthesis, the bag was removed, the anthers excised, and the bag was replaced and resealed. Blossoms that set fruit in the absence of pollen are apomictic.

Insect activity was noted in the field during morning, afternoon and evening periods. Insects were caught selectively when they were observed either clinging on the floral parts or actively foraging for floral nutrients on open flowers of *Erythronium americanum*. Each insect was placed in a separate vial containing 75% ethanol and examined for the presence of the host plant's pollen. Insects were keyed to species when possible.

On May 24, 1975 the flowers belonging to the four categories were harvested and checked for the presence of fruit and seed.

OBSERVATIONS

Those flowers that belonged to the two artificially isolated categories failed to set fruit (Table 1). Apparently, this species is self-incompatible and, since only the Emasculates approach the fruit production of the Controls, we may assume that *Erythronium americanum* is an obligate out-crosser.

Foragers carrying depositions of the host plant's pollen were collected during morning and afternoon periods as the perianths closed at dusk. One species of Coleoptera and six genera of Hymenoptera were found carrying *Erythronium americanum* pollen. All foragers fed while clinging to the floral parts. Feeding while hovering was never observed.

Individuals of *Asclera ruficollis* (Say) were found bearing a fine dusting of pollen on both the ventral and dorsal sides of the head, thorax, abdomen and legs. They were taken while they fed on the anthers or chewed on the stigma.

Pollen on all Hymenoptera was confined to the ventral side of the head, thorax and abdomen or deposited in the corbicular load. The only *Bombus bimaculatus* Cresson queen taken bearing a mixed load of host flower pollen and the pollen of another species bore the pollen of *Dicentra cucullaria* in her corbicular basket. *Nomada sulphurata* Sm. carried depositions of *Dentaria laciniata* pollen only. All *Andrena* spp. carried mixed loads, the *Nomada* sp. near *dentariae* Robt. and the *Nomada* sp. carried depositions of host plant pollen and the pollen of *Dentaria laciniata* (Table 2).

DISCUSSION

There is a significant drop between fruit production in Controls and Emasculates. I suspect that insects primarily concerned with the collection and consumption of *Erythronium americanum* pollen spent less time on the Emasculates, which did not allow sufficient time for the ventrally distributed pollen to be passed to the inverted stigma. Unlike *Asarum canadense* L., which displays floristic modifications for self-pollination (Wildman, 1950), and *Viola* spp., which are self-pollinated by insects (Beattie, 1971), *Erythronium americanum* appears to be one vernal species that relies on outcrossing for the production of seed.

Since *Apis mellifera* L. is not native to North America, we must conclude that pollination by this insect is a preadaptive process between an introduced vector and an indigenous plant. Also,

Table 1. **Flower vs. fruit production in Erythronium americanum.**

CATEGORY	Number of flowers tested	Number of withered flowers recovered	Number of flowers with fruit
CONTROLS	15	11	10
EMASCULATES	15	15	12
ISOLATES	15	12	0
ISO. EMASC.	15	11	0

Table 2. **Insect foragers on Erythronium americanum and the pollen carried.**

INSECT SPECIES	*Analysis of pollen carried by foragers* host only	host & other spp.	other spp. only	no pollen
COLEOPTERA:				
Asclera ruficollis	6	0	0	0
DIPTERA:				
Polenia rudis	0	0	0	1
HYMENOPTERA:				
Andrena carlini	0	4	0	0
Andrena spp.	2	3	0	1
Apis mellifera (workers)	3	0	0	0
Bombus bimaculatus (queens)	4	1	0	0
Dialictus coerulus	1	0	0	0
Nomada sp.	0	1	0	0
Nomada sp. (near *dentariae*)	1	1	0	0
Nomada sulphurata	0	0	1	0
Osmia atriventris	1	0	0	0
TOTALS	18	10	1	2

unlike vernal species like *Dicentra cucullaria,* anatomical modifications of the floral parts in *Erythronium americanum* do not appear to restrict pollination to a finite group of correspondingly modified vectors that belong to the same tribe, genus or species as in the former (Macior, 1970). Unlike vernal flowering populations of *Viola, Physalis, Salix, Polemonium reptans,* and *Claytonia virginica, Erythronium americanum* does not appear to be a major pollen source for entirely oligolectic species of solitary bees as described by Linsley (1958).

SUMMARY

Under experimental conditions, seed production in *Erythronium americanum* is entirely the result of outcrossing. Artificially isolated blossoms appear to be self-incompatible. Cross-pollination is effected by insects that forage by clinging to the floral parts rather than by hovering. Foragers bearing the host plant's pollen include *Asclera ruficollis, Apis mellifera* and indigenous populations of social and solitary bees. *Erythronium americanum* appears to share some vectors with colonies of vernal herbs with overlapping periods of anthesis as some insects collected on the host flower bore the pollen of two other species.

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